PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-017560

(43)Date of publication of application : 22.01.2002

(51)Int.Cl. A47J 27/00

(21)Application number : 2000-209416

(22)Date of filing : 11.07.2000

(71)Applicant : MATSUSHITA ELECTRIC IND CO LTD

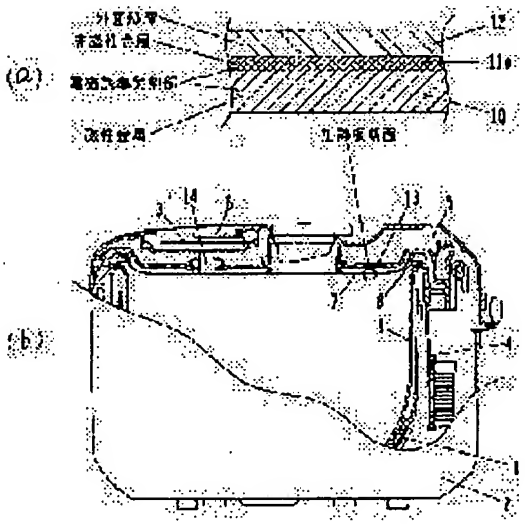
(72)Inventor : KOMA ATSUSHI
NISHIDA TAKASHI
KOYAMA MASAHIRO

(54) COVER HEATING PANEL FOR RICE COOKER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a heating panel for a rice cooker improving the heating efficiency of electromagnetic induction.

SOLUTION: Since the panel consists of a magnetic metallic layer 10 and a non-magnetic metallic layer 11 on its outer surface, rice can be cooked and warmed with generated heat efficiently with reduced temperature unevenness by electromagnetic induction heating.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than

h c g e e h h

DERWENT-ACC-NO: 2002-247921

DERWENT-WEEK: 200230

TITLE: Hot plate for electromagnetic induction heating type rice cooker, has copper layer which is thinner than the ferrite type stainless steel layer, and is arranged on reverse side of induction heating coil

PATENT-ASSIGNEE: MATSUSHITA DENKI SANGYO KK[MATU]

PRIORITY-DATA: 2000JP-0209416 (July 11, 2000)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 2002017560 A	January 22, 2002	N/A	005	A47J 027/00

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
JP2002017560A	N/A	2000JP-0209416	July 11, 2000

INT-CL (IPC): A47J027/00

ABSTRACTED-PUB-NO: JP2002017560A

BASIC-ABSTRACT:

NOVELTY - A copper layer (11a) and a ferrite type stainless steel layer (10), are arranged on the reverse side of an induction heating coil (13). The copper layer is thinner than the ferrite type stainless steel layer.

USE - For electromagnetic induction heating type rice cooker used for commercial purposes.

ADVANTAGE - Favorable heat generation and heat retention property is obtained by using copper layer in hot plate.

DESCRIPTION OF DRAWING(S) - The figure shows a sectional view of hot plate in rice cooker. (Drawing includes non-English language text).

Ferrite type stainless steel layer 10

Copper layer 11a

Induction heating coil 13

CHOSEN-DRAWING: Dwg.1/3

TITLE-TERMS: HOT PLATE ELECTROMAGNET INDUCTION HEAT TYPE RICE COOKER COPPER LAYER THINNER FERRITE TYPE STAINLESS STEEL LAYER ARRANGE REVERSE SIDE INDUCTION HEAT COIL

DERWENT-CLASS: P28 X25 X27

EPI-CODES: X25-B02A2; X27-C04;

SECONDARY-ACC-NO:
Non-CPI Secondary Accession Numbers: N2002-192349

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] It is the lid hot plate for rice cookers which is equipped with the exoergic section by which is formed of a magnetic metal layer and a non-magnetic metal layer, and electromagnetic induction is carried out, and it comes to constitute more thinly than said magnetic metal layer while said non-magnetic metal layer is allotted to a heating induction coil side from said magnetic metal layer.
[Claim 2] It is the lid hot plate for rice cookers equipped with the exoergic section by which is formed of a magnetic metal layer and a non-magnetic metal layer, and electromagnetic induction is carried out by which said non-magnetic metal layer was formed in a heating induction coil and the opposite side from said magnetic metal layer.
[Claim 3] The lid hot plate for rice cookers according to claim 1 which also equipped the heating induction coil and the opposite side of the exoergic section with the non-magnetic metal layer.
[Claim 4] A non-magnetic metal layer is a lid hot plate for rice cookers given in any 1 term of claims 1-3 which becomes as 0.1 to 2.0 times of the thickness from which the same epidermis electric resistance value as the epidermis electric resistance value which iron has is acquired.
[Claim 5] A non-magnetic metal layer is a lid hot plate for rice cookers given in any 1 term of claims 1-4 which plating comes to form.
[Claim 6] A non-magnetic metal layer is a lid hot plate for rice cookers given in any 1 term of claims 1-5 which come to give outside processing of anodic-oxidation-coatings processing or protective coating processing either at least.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the electromagnetic-induction heating type rice cooker used for ordinary homes and business use.
[0002]
[Description of the Prior Art] Current and the electromagnetic-induction heating type rice cooker widely marketed by the general world The line of magnetic force produced when passing the high frequency current to the heating induction coil with which the interior of a body was equipped In case it advances into the magnetic metal which can electromagnetic-induction heat the ferrite system stainless steel which constitutes a pan and a lid hot plate, an eddy current arises to a magnetic metal, the Joule's heat by the electric resistance of this eddy current occurs, a pan and a lid hot plate generate heat, and this heat is applied to cooking of rice.
[0003] Here, the typical thing of the conventional lid hot plate for electromagnetic-induction heating type rice cookers is formed with magnetic metals, such as ferrite system stainless steel, iron, and a permalloy, and makes this magnetic metal the exoergic section of electromagnetic-induction heating.
[0004]
[Problem(s) to be Solved by the Invention] However, with the above-mentioned conventional configuration, generally the exoergic section of a lid hot plate is limited to magnetic metals, such as ferrite system stainless steel, iron, and a permalloy, and non-magnetic metal, such as aluminum, copper, and titanium, was not applied to it by the exoergic section. Therefore, from the field of exoergic effectiveness, it saw and was not necessarily the optimal power design. Moreover, when it mainly generated heat only near the heating induction coil and it served as an elevated temperature, the hot plate may have been discolored only near the heating induction coil.
[0005] Moreover, in cooking rice and an incubation process, the boiled rice near the elevated-temperature part of the exoergic section dried with fault heating, and in the exoergic sections other than the above, the steam in a pan dewed with the lack of exoergic, and it became waterdrop, and it was dropped at up to boiled rice, boiled rice swelled up, and it had become a factor with ** BECHA. Moreover, when ferrite system stainless steel, iron, a permalloy, etc. were allotted to the outermost layer, since an appearance color was limited to the color of the silver network which is a metaled material color, it was what does not become better for the change in appearance. Therefore, in order to have raised design nature, paint etc. needed to be carried out and the various anodic-oxidation-coatings colors of aluminum, the anodic-oxidation-coatings color and high-temperature-oxidation color of titanium, or the copper material color was difficult for pulling out the beauty which comes from the material itself.
[0006]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, this invention constitutes the exoergic section by which is formed of a magnetic metal layer and a non-magnetic metal layer, and electromagnetic induction is carried out, and while being allotted to a heating

induction coil side from said magnetic metal layer, it comes to constitute said non-magnetic metal layer more thinly than said magnetic metal layer.

[0007]

[Embodiment of the Invention] According to invention according to claim 1, by making thickness of non-magnetic metal thin, the epidermis electric resistance value can become high, and it can be made to be able to act effectively as the exoergic section by electromagnetic induction, and temperature nonuniformity can be reduced.

[0008] According to invention according to claim 2, it becomes the more uniform electromagnetic-induction lid hot plate of internal temperature distribution especially.

[0009] According to invention according to claim 3, especially, it is made to act effectively as the exoergic section by electromagnetic induction, and becomes the more uniform electromagnetic-induction lid hot plate of internal temperature distribution.

[0010] According to invention according to claim 4, it becomes an electromagnetic-induction lid hot plate with good exoergic effectiveness especially.

[0011] According to invention according to claim 5, management of arrangement of a non-magnetic metal layer, thickness, etc. becomes easy irrespective of the configuration of a lid hot plate.

[0012] According to invention according to claim 6, in being able to take out various tints by various anodization especially, when it is titanium, the same tint can be taken out also by high temperature oxidation. Moreover, it also becomes possible to brew a peculiar metal color like copper or its alloy.

[0013]

[Example] (Example 1) One example of this invention is hereafter explained using a drawing etc.

[0014] Generally, when performing electromagnetic-induction heating, usually a metallic material with a high epidermis electric resistance value is used for the exoergic section of the lid hot plate for electromagnetic-induction heating. For example, in 430 of ferrite system stainless steel typical stainless steel, if the 25kHz high frequency current is passed to an induction coil, an epidermis electric resistance value can say that it is highly suitable for electromagnetic-induction heating with 9.4*10 to 4 ohm with 23.3*10 to 4 ohm, and iron. It is the ingredient which is as low as 0.39*10-4 as for 0.48*10 to 4 ohm, and copper, and does not usually fit electromagnetic-induction heating with aluminum on the other hand. Therefore, when a field is made to act on non-magnetic metal, a resistance field arises in non-magnetic metal, a resistance current flows, as for a field, non-magnetic metal cannot be passed, and the exothermic effect by electromagnetic-induction heating cannot usually be expected.

[0015] however -- if these non-magnetic metal layers also make thickness thin -- just -- being alike -- an epidermis electric resistance value rises and electromagnetic-induction heating is attained. That is, if this has a fully thin non-magnetic metal layer, since an epidermis electric resistance value becomes high, it will be hard coming to generate a resistance field, and a field will become easy to pass non-magnetic metal. An eddy current arises also to stainless steel by the passed field, and both said both non-magnetic metal layer and magnetic metal layers, such as stainless steel, generate heat. This invention uses this phenomenon, with the combination of a non-magnetic metal layer and a magnetic metal layer, even if non-magnetic metal is in hot-plate external surface, compared with the case of a mere magnetic metal layer monolayer, it generates heat more efficiently and cooking rice of it becomes possible.

[0016] Hereafter, the detail is explained. Drawing 1 is a rice cooker for 1.8L cooking rice of the method which heats a pan 9 and a hot plate 7 with electromagnetic-induction heating, and carries out cooking rice. The pan part heating induction coil 1, a body 2, the actuation display substrate 3, the heating control board 4, a lid 5, a control unit 6, a hot plate 7, the pan packing 8, a pan 9, the covering device heating induction coil 13, and the hot-plate section temperature detection sensor 14 are used as the main component parts. Although cooking rice and an incubation process are performed for rice and water after optimum dose ****** in a pan, this process is performed by the program control by the microcomputer.

[0017] A hot plate 7 carries out press forming of the clad plate which consists of copper 11a of the ferrite system stainless steel 10 of 0.8mm thickness, and 5-micrometer thickness, it is obtained, and copper 11a which is the ferrite system stainless steel 10 and non-magnetic metal which are a magnetic

metal is the exoergic layer of electromagnetic-induction heating. Since transparence polyester system protective coating 12 for protecting copper has been performed, the external surface of a hot plate 7 has the composition that the gloss of a copper base material is maintainable over a long period of time. Moreover, although ferrite system stainless steel was used as a magnetic metal layer material of a hot plate 7 in this example, an ingredient is not limited to this, and if it is the quality of the material in which electromagnetic induction is possible, it can apply any ingredients.

[0018] Moreover, in this example, although the 25kHz high frequency current flows in cooking rice to the covering device heating induction coil 13, in case the line of magnetic force generated from a covering device heating induction coil at this time advances into the copper and the ferrite system stainless steel layer which are the induction exoergic section of a hot plate 7, it produces an eddy current, it is the structure in which a hot plate 7 generates heat, a cooking-rice process and an incubation process are carried out by this heat, and boiled rice is cooked and kept warm.

[0019] In this example, although the 25kHz high frequency current was used, it is arbitrary to change this frequency according to a situation, and it is also arbitrary to change the thickness of a non-magnetic metal layer according to it.

[0020] Moreover, an above-mentioned exothermic effect becomes much more remarkable by making thickness of the non-magnetic metal layer of the electromagnetic-induction exoergic section into 0.1 to 2.0 times of the thickness from which the same epidermis electric resistance value as the epidermis electric resistance value which iron has is acquired. Here, thickness t of the non-magnetic metal for acquiring the same value as an iron epidermis electric resistance value can be drawn by the following formulas.

[0021] Rs of Rs/iron of delta* non-magnetic metal of t= non-magnetic metal -- here, delta is a skin depth, Rs is an epidermis electric resistance value, and delta and Rs are expressed with the following formulas.

[0022] delta=5.03*103*(rho/mu/f)1/2 Rs=rho/delta =1.99*10-4*(micro*rho*f) 1/2 -- here, rho is [permeability and f of the specific resistance value of the ingredient and mu] frequencies.

[0023] An iron epidermis electric resistance value is 9.4*10 to 4 ohm in 25kHz as above-mentioned. Working an electromagnetic-induction heating type rice cooker by the 25kHz high frequency current now, if aluminum is applied to an upper type, it will be set to t= 18 micrometers with t= 28 micrometers and copper, and will be set to t= 586 micrometers by titanium, and these ingredients show that good electromagnetic-induction heating like iron is obtained near [this] the field. Then, it is the purpose of this invention to compute the thickness of a non-magnetic metal layer required in order to acquire the same value as an iron epidermis electric resistance value in consideration of the frequency band to be used, to allot the non-magnetic metal layer which becomes thickness twice [0.1 to] the thickness of the to the external surface of a magnetic metal layer, and to acquire efficient generation of heat.

[0024] Moreover, although a hot plate 7 is located in the upper part of boiled rice unlike a pan 9 and it is not in contact with direct boiled rice Although there is also a duty of prevention with [/ dew condensation of a steam or other than the oven effectiveness of the boiled rice by heating] waterdrop since the part which receives a steam from the boiled rice in a pan in cooking rice and an incubation process, and waterdrop generates by dew condensation of a steam is hit By acquiring efficient generation of heat as above-mentioned, it becomes possible to perform cooking rice in high watt, and fine control peculiar to electromagnetic-induction heating can perform cooking rice corresponding to heating control if needed.

[0025] moreover, when it is non-magnetic metal and thermal conductivity forms high 13 times as many copper as this 11b in the side which has met the boiled rice of a hot plate 7 from the ferrite system stainless steel 10 When heat can reduce the temperature nonuniformity of propagation, an elevated-temperature part, and a low-temperature part also to the part distant from the covering device heating induction coil 13, a hot plate 7 By being heated to the hot-plate 7 **** low-temperature part which prevented elevated-temperature discoloration of a hot plate 7, and is separated from the covering device heating induction coil 13 at the time of cooking rice and incubation The waterdrop which dews hot-plate 7 **** can be lost, and when even about eight pan packing formed by the silicone rubber which is

carrying out the seal of a pan 9 and the hot plate 7 further conducts heat, the waterdrop which dews the pan packing 8 can also be decreased sharply.

[0026] When the copper 11a and 11b of non-magnetic metal with high thermal conductivity is formed in both sides of the side which has furthermore met boiled rice the heating induction coil side of a hot plate 7, it cannot be overemphasized that a hot plate 7 becomes possible [carrying out efficient generation of heat to homogeneity], the above-mentioned dew condensation reduction effectiveness is demonstrated still more effectively in cooking rice and incubation with homogeneity heating with the sufficient effectiveness from a hot plate 7, and the condition of boiled rice is raised.

[0027] Moreover, when there is an advantage which can change thickness comparatively freely by forming a non-magnetic metal layer by plating, as it changes thickness partially or plating is not attached partially, change is given to electromagnetic-induction heating reinforcement by the part, and it becomes possible to take out change to the temperature distribution of a hot plate as a result.

[0028] Moreover, a non-magnetic metal layer can take out various colors, and can raise design nature while it can improve corrosion resistance by having performed anodic-oxidation-coatings processing, protective coating processing, or these both processing.

[0029] Moreover, although the hot plate for electromagnetic-induction heating type rice cookers of this example is giving high endurance while the outer layer of the electromagnetic-induction exoergic section is copper, performs clear paint of a polyester system in consideration of that it is easy to get damaged, being easy to discolor, etc. and maintains a copper beautiful base material color In order that especially this outside coating may not be limited to a polyester system, either and may raise [and also] endurance, even if it considers as a multilayer coating tip or uses a coloring coating, it is satisfactory in any way.

[0030] (Result of comparative experiments) The comparison result of the above-mentioned example 1 and the conventional example is shown hereafter. As shown in drawing 2 here, the eddy current calorific value in 25kHz is measured with the hot plate for rice cookers shown in the example 1 of this invention by making into the example of a comparison the hot plate for electromagnetic-induction heating type rice cookers which has the conventional typical configuration obtained by carrying out press forming of the clad plate which consists of the ferrite system stainless steel 10 of 0.8mm thickness. Here, all the rice cooker configurations of those other than a hot plate presuppose that it is the same. When the current which generation of heat of 1000W produces is given to the example of a comparison which the exoergic layer of the hot plate for rice cookers becomes only from ferrite system stainless steel, in the example 1 which has 5 micrometers of copper layers of non-magnetic metal outside, generation of heat of about 1100 W is acquired, and generation of heat goes up about 10%.

[0031] Although the gross calorific value of the hot plate of this example 1 adds each calorific value of copper and a ferrite system stainless steel layer and is obtained, the gross calorific value also changes as are shown in drawing 3 and the thickness of the copper which is a non-magnetic layer changes. It will be in the condition that the calorific value near 5 micrometer with copper thickness higher than the example of a comparison for which gross calorific value uses the maximal value by the next door and the ferrite system stainless steel independent is obtained in the conditions of these comparative experiments, and in this example, this fact is used and it is considering as the configuration which allotted the 5-micrometer copper layer to the external surface of ferrite system stainless steel.

[0032] Although 5-micrometer copper became the conditions made to generate heat most efficiently in this example 1, in order for the thickness of the non-magnetic metal which can obtain the maximum calorific value to change, the thickness of non-magnetic metal needs to choose the thickness according to a situation by electrical properties, such as an inductance of the class of non-magnetic metal, the frequency to be used, and an induction-heating coil.

[0033] Anyway, as this example 1 shows, it becomes possible [offering the hot plate for electromagnetic-induction heating type rice cookers accompanied by the beautiful appearance which employed the metal material color efficiently] while it can carry out cooking rice and an incubation process, the hot plate for rice cookers of this invention obtaining high calorific value, using non-magnetic metal for an electromagnetic-induction heating unit.

[0034]
[Effect of the Invention] As mentioned above, while it is possible to acquire good generation of heat to cooking rice and incubation according to this invention, using non-magnetic metal for an electromagnetic-induction heating unit, it is possible to offer the hot plate for electromagnetic-induction heating type rice cookers accompanied by the beautiful appearance which employed the metal material color efficiently.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The rice cooker-related explanatory view in which the hot plate for rice cookers of one example of this invention is used
[Drawing 2] The sectional view of the hot plate for **** rice cookers
[Drawing 3] The transition property Fig. of the calorific value accompanying change of the thickness of the copper of the hot plate for **** rice cookers
[Description of Notations]
7 Hot Plate
10 Ferrite System Stainless Steel
11a copper
11b copper
12 Protective Coating
13 Covering Device Heating Induction Coil

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)**公開特許公報**（Ａ）　(11)特許出願公開番号
特開2002－17560
（P2002－17560A）
(43)公開日　平成14年１月22日(2002.1.22)

(51)Int.Cl.'	識別記号	Ｆ Ｉ	ﾃｰﾏｺｰﾄﾞ(参考)
Ａ４７Ｊ　27/00	１０３	Ａ４７Ｊ　27/00	１０３Ａ　４Ｂ０５５
			１０３Ｎ

審査請求　未請求　請求項の数６　ＯＬ　（全５頁）

(21)出願番号　特願2000－209416(P2000－209416)

(22)出願日　平成12年７月11日(2000.7.11)

(71)出願人　000005821
松下電器産業株式会社
大阪府門真市大字門真1006番地

(72)発明者　高麗　敦
大阪府門真市大字門真1006番地　松下電器産業株式会社内

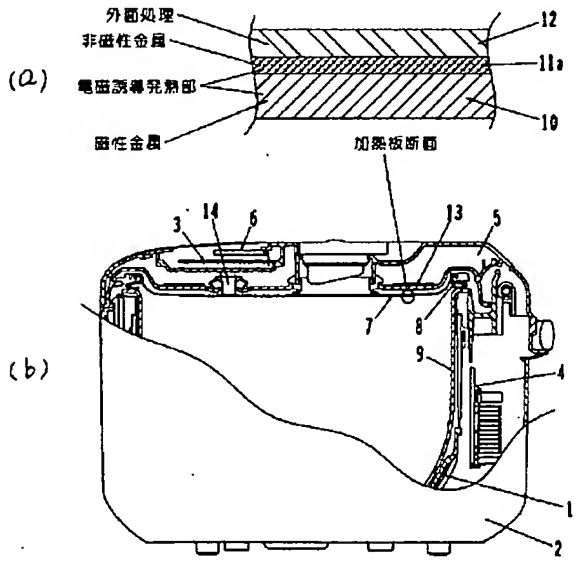
(72)発明者　西田　隆
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(74)代理人　100097445
弁理士　岩橋　文雄　（外２名）

最終頁に続く

(54)【発明の名称】　炊飯器用蓋加熱板

(57)【要約】
【課題】　電磁誘導の加熱効率を向上させた炊飯器用加熱板を提供すること。
【解決手段】　磁性金属層１０とその外面の非磁性金属層１１から成ることにより、電磁誘導加熱により効率良く、しかも温度ムラも少なく、発熱した熱により炊飯・保温することが可能となる。



1

【特許請求の範囲】

【請求項1】　磁性金属層と非磁性金属層により形成され電磁誘導される発熱部を備え、前記非磁性金属層は、前記磁性金属層より加熱誘導コイル側に配されるとともに、前記磁性金属層よりも薄く構成してなる炊飯器用蓋加熱板。

【請求項2】　磁性金属層と非磁性金属層により形成され電磁誘導される発熱部を備え、前記非磁性金属層は、前記磁性金属層より加熱誘導コイルと反対側に形成された炊飯器用蓋加熱板。

【請求項3】　発熱部の加熱誘導コイルと反対側にも非磁性金属層を備えた請求項1記載の炊飯器用蓋加熱板。

【請求項4】　非磁性金属層は、鉄が有する表皮電気抵抗値と同一の表皮電気抵抗値が得られる厚みの0．1～2．0倍としてなる請求項1～3のいずれか1項に記載の炊飯器用蓋加熱板。

【請求項5】　非磁性金属層は、鍍金により形成されてなる請求項1～4のいずれか1項に記載の炊飯器用蓋加熱板。

【請求項6】　非磁性金属層は、少なくとも、陽極酸化皮膜処理、または、保護コーティング処理のいずれかの外面処理を施してなる請求項1～5のいずれか1項に記載の炊飯器用蓋加熱板。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、一般家庭及び業務用に使用される電磁誘導加熱式炊飯器に関するものである。

【0002】

【従来の技術】現在、広く世間一般に市販されている電磁誘導加熱式炊飯器は、本体内部に備えられた加熱誘導コイルに高周波電流を流す時に生じる磁力線が、鍋および蓋加熱板を構成するフェライト系ステンレス等の電磁誘導加熱可能な磁性金属に進入する際に、磁性金属に渦電流が生じ、この渦電流の電気抵抗によるジュール熱が発生して鍋および蓋加熱板が発熱し、この熱を米の調理に応用するものである。

【0003】ここで、従来の電磁誘導加熱式炊飯器用蓋加熱板の典型的なものは、フェライト系ステンレス、鉄、パーマロイ等の磁性金属で形成され、この磁性金属を電磁誘導加熱の発熱部としているものである。

【0004】

【発明が解決しようとする課題】しかしながら、上記従来の構成では、蓋加熱板の発熱部は、一般的にフェライト系ステンレス、鉄、パーマロイ等の磁性金属に限定されており、アルミニウム、銅、チタンといった非磁性金属を発熱部に応用されていなかった。そのため、発熱効率の面から見て、必ずしも最適な電力設計ではなかった。また、加熱誘導コイル近傍のみが主に発熱し高温となることにより、加熱板は加熱誘導コイル近傍のみが変色する可能性があった。

2

【0005】また、炊飯・保温工程において発熱部の高温部分近くのご飯が過加熱により乾燥し、上記以外の発熱部では発熱不足により鍋内の蒸気が結露し水滴となり、ご飯上へ滴下し、ご飯のふやけやべチャつきの要因となっていた。また、フェライト系ステンレス、鉄、パーマロイ等が最外層に配される場合、外観色は金属の素材色であるシルバー系統の色に限定されるため、外観的に代わり映えしないものであった。そのため、意匠性を向上させるには、塗装等する必要があり、アルミニウムの各種陽極酸化皮膜色、チタンの陽極酸化皮膜色や高温酸化色、あるいは銅の素材色等、素材そのものからくる美しさを引き出すことは困難であった。

【0006】

【課題を解決するための手段】上記課題を解決するために本発明は、磁性金属層と非磁性金属層により形成され電磁誘導される発熱部を構成し、前記非磁性金属層は、前記磁性金属層より加熱誘導コイル側に配されるとともに、前記磁性金属層よりも薄く構成してなるものである。

【0007】

【発明の実施の形態】請求項1記載の発明によれば、非磁性金属の厚みを薄くすることにより、その表皮電気抵抗値が高くなり、電磁誘導による発熱部として有効に作用させ、また温度ムラを低減させることができる。

【0008】請求項2記載の発明によれば、特に、内部温度分布のより均一な電磁誘導蓋加熱板となる。

【0009】請求項3記載の発明によれば、特に、電磁誘導による発熱部として有効に作用させ、かつ内部温度分布のより均一な電磁誘導蓋加熱板となる。

【0010】請求項4記載の発明によれば、特に、発熱効率の良好な電磁誘導蓋加熱板となる。

【0011】請求項5記載の発明によれば、蓋加熱板の形状に拘わらず、非磁性金属層の配置や厚み等の管理が容易となる。

【0012】請求項6記載の発明によれば、特に、各種陽極酸化によりさまざまな色合いが出せるうえ、チタンの場合には高温酸化によっても同様の色合いが出せる。また、銅やその合金のような独特な金属色を醸し出すことも可能となる。

【0013】

【実施例】（実施例1）以下、本発明の一実施例について、図面等を用いて説明する。

【0014】一般的に、電磁誘導加熱を行なう場合、電磁誘導加熱用の蓋加熱板の発熱部には表皮電気抵抗値の高い金属材料を使用するのが普通である。例えば、代表的なフェライト系ステンレスの430ステンレスでは、25kHzの高周波電流を誘導コイルに流すと、表皮電気抵抗値が23．3＊10－4Ω、鉄では9．4＊10－4Ωと高く電磁誘導加熱に適していると言える。一

方、アルミニウムでは0．４８＊１０－４Ω、銅は0．３９＊１０－４と低く、通常は電磁誘導加熱には適さない材料である。そのため、通常、非磁性金属に磁界を作用させた場合、非磁性金属に反抗磁界が生じ反抗電流が流れて、磁界は非磁性金属を通過できず、電磁誘導加熱による発熱作用は期待できない。

【００１５】しかしながら、これらの非磁性金属層も厚みを薄くしていくと、ついには表皮電気抵抗値が上昇し、電磁誘導加熱可能となる。即ち、これは、非磁性金属層が十分に薄いと、表皮電気抵抗値が高くなるために反抗磁界が生じにくくなり、磁界が非磁性金属を通過しやすくなる。その通過した磁界によりステンレスにも渦電流が生じ、前記非磁性金属層とステンレス等の磁性金属層の両方が共に発熱するものである。本発明はこの現象を利用したものであり、非磁性金属層と磁性金属層の組み合わせによって、非磁性金属が加熱板外面にあっても、単なる磁性金属層単層の場合に比べて、より効率よく発熱し、炊飯が可能となるものである。

【００１６】以下、その詳細について、説明する。図１は電磁誘導加熱により鍋９および加熱板７を加熱し炊飯する方式の１．８Ｌ炊飯用の炊飯器であり、鍋部加熱誘導コイル１、本体２、操作表示基板３、加熱制御基板４、蓋体５、操作部６、加熱板７、鍋パッキン８、鍋９、蓋部加熱誘導コイル１３、および加熱板部温度検知センサー１４を主な構成部品とし、鍋内に米及び水を適量加えた後、炊飯及び保温工程を実行するが、この工程はマイクロコンピュータによるプログラム制御により実行される。

【００１７】加熱板７は、０．８mm厚のフェライト系ステンレス１０、５μm厚の銅１１ａからなるクラッド材をプレス成形して得られるものであり、磁性金属であるフェライト系ステンレス１０と非磁性金属である銅１１ａは電磁誘導加熱の発熱層である。加熱板７の外面は銅を保護するための透明ポリエステル系保護コーティング１２が施してあるため、銅基材の光沢を長期間に渡り維持できる構成となっている。また、本実施例では加熱板７の磁性金属層素材として、フェライト系ステンレスを用いたが、材料はこれに限定されるものではなく、電磁誘導可能な材質であればいかなる材料でも応用可能である。

【００１８】また、本実施例において、蓋部加熱誘導コイル１３には炊飯中に２５ｋＨｚの高周波電流が流れるが、このとき蓋部加熱誘導コイルより発生する磁力線は加熱板７の誘導発熱部である銅及びフェライト系ステンレス層に進入する際に渦電流を生じ、加熱板７が発熱する仕組みであり、この熱によって炊飯工程および保温工程が遂行され、ご飯が調理・保温される。

【００１９】本実施例では、２５ｋＨｚの高周波電流を用いたが、状況によってこの周波数を変更することは任意であるし、また、それに応じて非磁性金属層の厚みを変えることも任意である。

【００２０】また、電磁誘導発熱部の非磁性金属層の厚みを、鉄が有する表皮電気抵抗値と同一の表皮電気抵抗値が得られる厚みの０．１～２．０倍とすることにより、上述の発熱作用は一層顕著となる。ここで、鉄の表皮電気抵抗値と同一の値を得るための非磁性金属の厚みｔは以下の計算式により導き出せる。

【００２１】ｔ＝非磁性金属のδ＊非磁性金属のＲｓ／鉄のＲｓここで、δは表皮深さ、Ｒｓは表皮電気抵抗値であり、δとＲｓは以下の式で表わされる。

【００２２】δ＝５．０３＊１０３＊（ρ／μ／ｆ）１／２

Ｒｓ＝ρ／δ＝１．９９＊１０－４＊（μ＊ρ＊ｆ）１／２

ここで、ρはその材料の固有抵抗値、μは透磁率、ｆは周波数である。

【００２３】上述の通り、鉄の表皮電気抵抗値は２５ｋＨｚにおいて９．４＊１０－４Ωである。今、２５ｋＨｚの高周波電流で電磁誘導加熱式炊飯器を稼動させるとして、上式にアルミニウムを当てはめるとｔ＝２８μｍ、銅ではｔ＝１８μｍ、チタンではｔ＝５８６μｍとなり、この領域付近でこれらの材料は鉄のような良好な電磁誘導加熱が得られることを示している。そこで、使用する周波数帯を考慮し、鉄の表皮電気抵抗値と同一の値を得るために必要な非磁性金属層の厚みを算出し、その厚みの０．１～２倍の厚みとなる非磁性金属層を磁性金属層の外面に配し、効率の良い発熱を得る事が本発明の目的である。

【００２４】また、加熱板７は鍋９と違いご飯の上部に位置し直接ご飯に接触していないのであるが、炊飯・保温工程において鍋内ご飯より水蒸気を受け水蒸気の結露により水滴が発生する部位にあたるため加熱によるご飯のオーブン効果の他にも水蒸気の結露による水滴付きの防止の役目もあるのであるが、上述の通り効率の良い発熱を得る事により高ワットで炊飯を行うことが可能となり、また電磁誘導加熱特有の細かな制御により、必要に応じた加熱制御に対応した炊飯を行うことができる。

【００２５】また加熱板７のご飯と対面している側に非磁性金属であり熱伝導率がフェライト系ステンレス１０より１３倍の高い銅１１ｂを形成した場合には、加熱板７は蓋部加熱誘導コイル１３から離れた部位にも熱が伝わり、高温部分と低温部分の温度ムラを低減することができることにより、加熱板７の高温変色を防止し，また炊飯・保温時において蓋部加熱誘導コイル１３から離れている加熱板７ふち低温部分まで加熱されることにより、加熱板７ふちに結露する水滴を無くし、更には鍋９と加熱板７とをシールしているシリコンゴムで形成された鍋パッキン８近傍まで熱を伝えることにより鍋パッキン８に結露する水滴をも大幅に減少することができる。

【００２６】さらに加熱板７の加熱誘導コイル側とご飯

と対面している側の両面に熱伝導率の高い非磁性金属の銅１１ａ、１１ｂを形成した場合には、加熱板７は効率の良い発熱を均一に行うことが可能となり、加熱板７からの効率の良い均一加熱により炊飯・保温において上述の結露低減効果をさらに効果的に発揮し、ご飯の状態を向上させる事は言うまでもない。

【００２７】また、非磁性金属層を鍍金により形成することにより、比較的自由に厚みが変更できる利点がある上、部分的に厚みを変えたり、部分的に鍍金を付けないようにして、部位により電磁誘導加熱強度に変化が付けられ、結果として加熱板の温度分布に変化を出すことが可能となる。

【００２８】また、非磁性金属層は、陽極酸化皮膜処理または、保護コーティング処理、あるいはこれら両者の処理を施したことにより、耐食性を向上できるとともに、さまざまな色を出すことができ、意匠性を高めることができる。

【００２９】また、本実施例の電磁誘導加熱式炊飯器用加熱板は、電磁誘導発熱部の外層が銅であり、傷つきやすいこと、変色しやすいこと等を考慮してポリエステル系のクリア塗装を施し、銅の美しい基材色を保ちながら高い耐久性を持たせているが、この外面コーティングも特にポリエステル系に限定されるものではなく、また、さらに、耐久性を向上させるために多層コーティングとしたり、着色塗料を用いても何ら問題はない。

【００３０】（比較実験の結果）以下、上記実施例１と従来例との比較結果を示す。ここで、図２に示すように、０．８ｍｍ厚のフェライト系ステンレス１０から成るクラッド材をプレス成形して得られる従来の典型的な構成を有する電磁誘導加熱式炊飯器用加熱板を比較例として、本発明の実施例１に示す炊飯器用加熱板と、２５ｋＨｚにおける渦電流発熱量を比較する。ここでは、加熱板以外の炊飯器構成は全て同一とする。炊飯器用加熱板の発熱層がフェライト系ステンレスのみからなる比較例に１０００Ｗの発熱が生じる電流を与えた時、外面に非磁性金属の銅層５μｍを有する実施例１では約１１００Ｗの発熱が得られ、約１０％発熱が上昇する。

【００３１】本実施例１の加熱板の総発熱量は銅とフェライト系ステンレス層の各発熱量を加算して得られるが、図３に示すように、非磁性層である銅の厚みが変化していくにつれてその総発熱量も変化していく。本比較実験の条件においては銅の厚みが５μｍ付近で総発熱量が極大値をとなり、フェライト系ステンレス単独で用いる比較例よりも高い発熱量が得られる状態となり、本実施例ではこの事実を利用し、５μｍの銅層をフェライト系ステンレスの外面に配した構成としている。

【００３２】本実施例１では、５μｍの銅が最も効率よく発熱させる条件となったが、非磁性金属の種類、使用する周波数、誘導加熱コイルのインダクタンス等の電気特性によって、最大発熱量を得られる非磁性金属の厚みは変化するため、非磁性金属の厚みは状況に応じた厚みを選択する必要がある。

【００３３】いずれにせよ、本実施例１が示すように、本発明の炊飯器用加熱板は電磁誘導加熱部に非磁性金属を用いながら、高い発熱量を得つつ炊飯・保温工程を遂行することが可能であるとともに、金属素材色を生かした美しい外観を伴った電磁誘導加熱式炊飯器用加熱板を提供することが可能となる。

【００３４】

【発明の効果】以上のように、本発明によれば、電磁誘導加熱部に非磁性金属を用いながら、炊飯・保温に良好な発熱を得ることが可能であるとともに、金属素材色を生かした美しい外観を伴った電磁誘導加熱式炊飯器用加熱板を提供することが可能である。

【図面の簡単な説明】

【図１】本発明の一実施例の炊飯器用加熱板が使用される炊飯器関連の説明図

【図２】同、炊飯器用加熱板の断面図

【図３】同、炊飯器用加熱板の銅の厚みの変化に伴う発熱量の推移特性図

【符号の説明】

７　加熱板

１０　フェライト系ステンレス

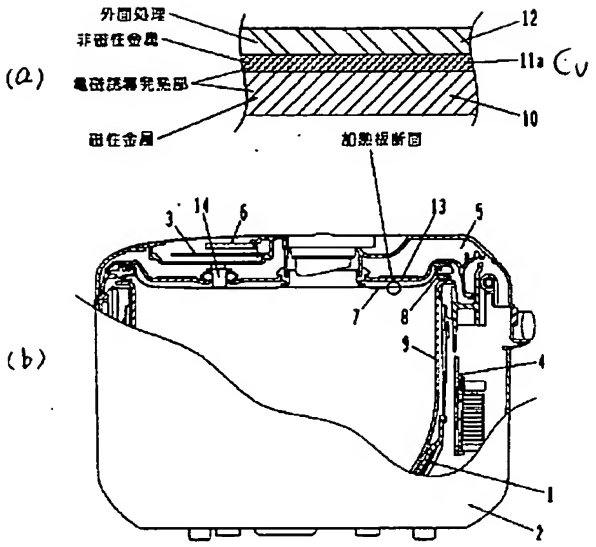
１１ａ銅

１１ｂ銅

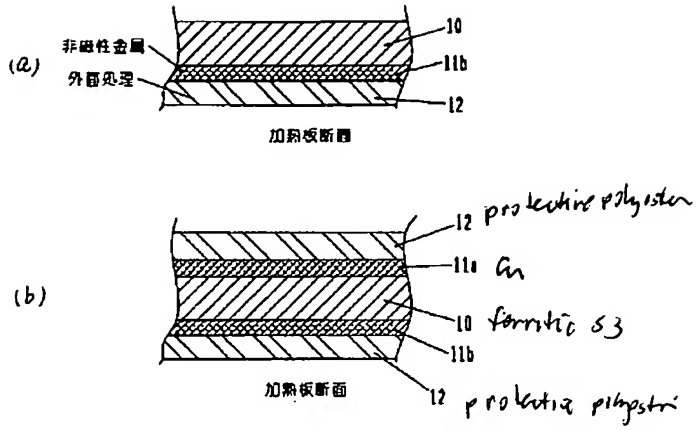
１２　保護コーティング

１３　蓋部加熱誘導コイル

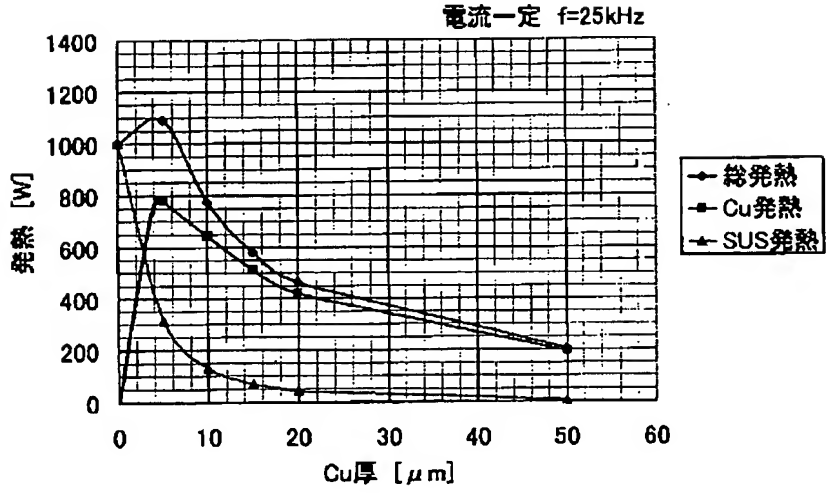
【図1】



【図2】



【図3】



フロントページの続き

(72)発明者　小山　政博
大阪府門真市大字門真1006番地　松下電器
産業株式会社内

Fターム(参考)　4B055 AA03 BA23 BA57 CA02 CA09
CA36 CA71 CB16 CC04 CC16
CC17 CC27 CC46 CD02 CD41
DA02 DA04 DB01 DB14 DB21
DB22 FB05 FB06 FB46 FC02
FC05 FC08 FD03 FD10 FE02
FE10